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(72) Ballantyne, Douglas J., CA
(72) Mulhall, Michael, CA
(73) PAXTON DEVELOPMENTS INC., CA

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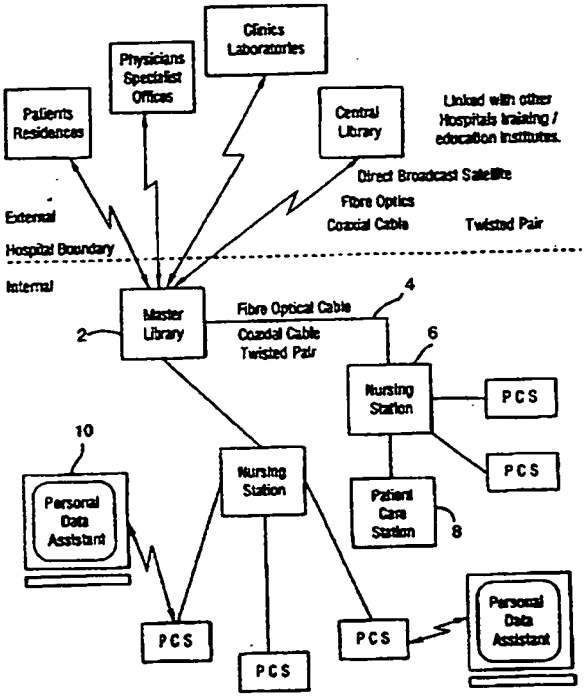
(54) **METHODE ET DISPOSITIF POUR LA DISTRIBUTION ELECTRONIQUE D'INFORMATION MEDICALE ET DE SERVICES AUX PATIENTS**

(54) **METHOD AND APPARATUS FOR THE ELECTRONIC DISTRIBUTION OF MEDICAL INFORMATION AND PATIENT SERVICES**



(57) This new and unique method and apparatus is used for the distribution and administration of medical services, entertainment services, electronic health records, educational information, etc. through a patient's individual electronic patient care station (PCS) interconnected to a master library storing data in digitized compressed electronic signal format, through a local medical information network. The patient/medical personnel interact with this medical information network through the unique PCS and receives the requested service or data from the master library. The data is then displayed either on the associated television set or video monitor or through wireless/IR communications to a peripheral personal data assistant (pen based computer technology). The data for text, audio, and video information is all compressed digitally to facilitate distribution and only decompressed at the final stage before viewing/interaction. Through this method and apparatus, many operations of a typical Hospital would be rendered paperless.

ABSTRACT OF THE DISCLOSURE

This new and unique method and apparatus is used for the distribution and administration of medical services, entertainment services, electronic health records, educational information, etc. through a patient's individual electronic patient care station (PCS) interconnected to a master library storing data in digitized compressed electronic signal format, through a local medical information network. The patient/medical personnel interact with this medical information network through the unique PCS and receives the requested service or data from the master library. The data is then displayed either on the associated television set or video monitor or through wireless/IR communications to a peripheral personal data assistant (pen based computer technology). The data for text, audio, and video information is all compressed digitally to facilitate distribution and only decompressed at the final stage before viewing/interaction. Through this method and apparatus, many operations of a typical Hospital would be rendered paperless.

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for distribution and administration of medical services, entertainment services, electronic health records, and educational information useful in hospitals, other types of health care facilities, and patients' homes. Presently, some hospitals are automated only to the extent of storing basic patient information, such as patient's name and address, admitting doctor, type of ailment, etc., electronically in computer memory, to be accessed by administrative staff or, at nursing stations, by nurses or other medical personnel. Otherwise, much patient information is collected manually and stored on pages in the patient's file. Of interest to the present invention is our U.S. Patent No. 5,133,079 entitled an apparatus for the distribution of movies, in which entertainment services, in the form of movies or the like, are delivered electronically in digitally compressed form from a master library to the home or other location of a customer.

An object of the present invention is to provide a more automated system for distribution and administration of medical services, entertainment services, electronic health records and the like for hospitals, other health care facilities, and the patient's domestic premises.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided an electronic information system for distribution of medical information and patient services which comprises:

(a) a data source in the form of a master library storing data in digitized compressed electronic signal format;

(b) a communications interconnection system electronically associated with the master library;

(c) an automated nursing station electronically associated with the master library through the communications interconnection system for temporary storage of a patient's health records, comprising computer means incorporating a client/server configuration and sufficient memory to temporarily store health records for patients monitored by this station;

(d) an electronic patient care station comprising:

(i) a monitor screen for display of normal NTSC video, RGB video and other interfaced/non-interlaced digital video formats;

(ii) interface means to electronically communicate through the communications interconnection system with the master library and with the nursing station;

(iii) a wireless/IR transmitter/receiver to communicate with a pen based computer device;

(iv) an input entry device to facilitate the patient/medical staff communication within the system; and

(v) compression and decompression means for data passed to and from the patient care station.

In a preferred embodiment of the present invention, the system comprises a plurality of nursing stations and one or more different patient care stations which are electronically associated with each of the nursing stations. It is preferred that the master library be adapted to store data preferably in digital compressed form selected from one or more of the following:

(a) patient/medical staff health record information,

(b) clinical data including X-Ray, MRI and video images,

(c) relevant laboratory data to support medical diagnoses and investigations,

(d) educational/training information in video or textual format for the training of medical personnel and patient requirements,

(e) pharmaceutical databases,

(f) entertainment audio/video data,

(g) monitored video of critical areas such as operating rooms and psychiatric wards,

(h) general security video monitoring data, and

(i) management information data including accounting, billing and inventory control/ordering services.

As well, the master library is preferably provided with means to receive and store, in digitally compressed form, data from one or more of the following:

(a) physicians' offices;

(b) clinics and laboratories;

(c) video entertainment libraries;

(d) electronic medical libraries;

(e) hospital security, patient and operating room monitoring information; and

(f) patients' residences.

Through the use of such an electronic information system, many record keeping operations of a typical hospital can be rendered paperless. As well, the collection and distribution of information in the hospital relating to patients, and the delivery of services to patients, as well as many other aspects of hospital administration are significantly facilitated through the use of the system according to the present invention, resulting in enhanced healthcare quality.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and advantages of the invention will become apparent upon reading the following detailed description and upon referring to the drawings in which:

FIGURE 1 is a schematic block diagram of a system for distribution of medical information and patient services in a hospital or other such health care institutions, physicians' offices and patients' residences, in accordance with the present invention.

FIGURE 2 is a schematic block diagram of an example embodiment of a configuration of the master library of Figure 1.

FIGURE 3 is a schematic block diagram of an example embodiment of systems software architecture of the system of Figure 1.

FIGURE 4 is a schematic diagram of the apparatus and its manner interconnection to the other components of this system, of an example embodiment of the patient care station of Figure 1.

FIGURE 5 is a schematic block diagram of the internal configuration of the patient care station of Figure 4.

FIGURE 6 is a schematic view of an example embodiment of a system for patient information input, as well as access and retrieval of that information, in accordance with the present invention.

FIGURES 7a and 7b are schematic views of an example embodiment of a configuration of the central library of Figure 1.

While the invention will be described in conjunction with

illustrated embodiments, it will be understood that it is not intended to limit the invention to such embodiments. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the drawings, similar features have been given similar reference numerals.

The medical information network according to the present invention consists of all the related hardware and software components of a master library (ML) (2), a communications interconnection system (4), the distributed processing nursing stations (6), individual bedside patient care stations (PCS) (8), and integrated personal data assistants (PDA) (10). Figure 1 is a schematic block diagram of the overall system.

The ML, situated locally within the physical boundary of each hospital or by geographical regions serving several hospitals, is configured as a client/server network.

It acts as a medical data depository for all text, audio, and video material including text, graphics, still images, full motion video, and sound/audio information. It includes the storage and processing capabilities to satisfy all administration, medical staff, and patient service requirements. Data will usually be stored in compressed digital format, using typical data compression techniques for text and video image information to minimize memory

storage and to facilitate the transmission of data to interconnected user/patient locations. These compression algorithms may consist of those listed as follows but are not necessarily limited to those identified:

Text	-	Run-length encoding
	-	Huffman encoding
	-	Arithmetic coding
	-	String matching techniques
	-	LZ-77 and 78 algorithms
Video	-	MPEG I and II standards
	-	JPEG standard
	-	Fractals
	-	Digital Video Interactive (DVI)
	-	Audio Video Interleaved (AVI)
	-	Quicktime
	-	Vector Quantization (VQ)

The types of data stored in this master library include, but not limited to:

(a) all patient/medical staff health record information,

(b) all clinical data including such items as X-Ray, MRI video images, etc.

(c) all relevant laboratory data to support medical diagnosis and investigations,

(d) educational/training information in video and/or textual format for the training of medical personnel and patient requirements,

(e) pharmaceutical databases,

(f) entertainment audio/video data,

(g) monitored video of critical areas such as operating rooms, psychiatric wards, etc.

(h) general security video monitoring data,

(i) management information data including account/billing and inventory control/ordering services.

For the distribution of video entertainment information the concept described in U.S. Patent 5,133,079 "Method and Apparatus for the Distribution of Movies" is incorporated in this system.

The ML is configured around the necessary number of computer processors to implement the storage and processing of the previously identified items (refer to Figure 2). It is internally connected through an appropriate Local Area Network (22) (includes IEEE 802.3 or Ethernet, IEEE 802.4 or Token Bus, and IEEE 802.5 or Token Ring, etc.) and where required through a high speed data bus. This high speed bus (24) can be based on High-Speed Serial Interface (HSSI), High-Performance Parallel Interface (HiPPI), Fiber Distributed Data Interface (FDDI), Integrated Services Data Network (ISDN, various configurations), or any other means that

facilitate the rapid distribution of data. These internal networks are interfaced with the Hospital information network through the communications controller (26). This controller is responsible for network channel assignment, the multiplexing and demultiplexing of data, signal modulation/demodulation, and all data routing between the networks (i.e. collision detection and avoidance, priority scheduling, etc.). Overall coordination is effected through the communications processor (38). Because of the uniqueness of the operations of individual hospitals, the data networking architecture of each hospital may be customized accordingly.

The memory storage media can consist of dedicated or combinations thereof of memory devices such as juke boxes, magnetic memory, magneto or electro-optical memory (28), high speed solid state memory (30), high density tape, etc. to be utilized in accordance with the specific application as required. Such mass memory components as Ampex DST (32) and Sony's CD-ROM technologies could be utilized. Within the ML is/are dedicated video server(s) necessary for the distribution of the video services (video servers (34) are available from DEC, Silicon Graphics, N-Cube, or ATT/NCR). To facilitate the compression of data, whether text or audio/video data, suitable compression capabilities (36) encompassing all the necessary software and associated hardware are included in this library. Dedicated text scanning units and imaging systems (40) (Xerox) can be integrated with the ML if so required.

The ML is interconnected to distributed user sites within the confines of the hospital through fiber optic cable, coaxial cable, and/or twisted pair cabling (42). These users can be

stand alone dedicated processors and/or distributed system processors such as those located at the nursing stations. The use of wireless communications will also be utilized in areas where it is difficult to install suitable cabling or simply areas where wireless communications are more economical.

The ML may be linked to external sources via Direct Broadcast Satellite (DBS) equipment, to receive or transmit relevant information. It can be also be linked to external clinics, other hospitals, medical schools, general practitioner's offices, and patients' residences through landline communications (twisted pair, coaxial cabling, fiber optic cable), DBS or wireless communications (44). A multimedia electronic mail system would be implemented amongst authorized users. This would facilitate the interaction between external users and the ML i.e. a general practitioner wants to inquire on the latest health care status of one of his/her patients.

The ML would also be responsible for the voice switching communications (46), the interface between the patient and the public telephone network. This interface could be directly with the twisted pair network already in place in the hospital, with new fiber optic networks, or a multiplexed system of data, video, and voice over a common coaxial network (cable switched voice) that may be the hospital's medical information network already in place. The appropriate billing and accounting systems are also implemented to monitor patient usage. This voice switching processor would also accommodate communications through the wireless personal communications systems.

The entire ML and associated medical information network is based on an open client/server computing environment whose systems software architecture could be based on the UNIX based Operating System (OS), Windows NT, or other compatible OS. In this open OS environment the software "client/user" could use any vendor application software and the OS would provide the appropriate resource "server" to satisfy the user requirement. As a result, it will be easy to add or change server functions, for they do not interact directly with the central processor hardware. A typical open client/server configuration is depicted in Figure 3. The system applications will include management information services, all accounting/billing services, inventory control, medical data retrieval, health record retrieval and entry, etc. This overall management operation resides over an information database. The system software will provide a full data storage, search and retrieval capability (as in Fulcrum's SearchTools utility) where every word is a keyword, and thus every word can be searched. This is significantly different from typical keyword searching that only allows specific terms and fields to be set-up as searchable. The following features are inherent in the storage, search and retrieval system:

(1) the system is fully compatible across an array of hardware platforms. This ensures that the distributed nursing stations will interface, without having to re-process the stored data, with the larger more complex ML.

(2) large data collections normally have complex search requirements which can be wieldy and impractical. In order to facilitate data searches and retrievals of large data collections, the proposed system indexes the data. The index files are then used to support the complex searches, and only those documents that satisfy the search criteria are retrieved.

(3) multiple sources or collections of data can be simultaneously searched. However, identical documents or health records can be maintained in different collections i.e. infants under the age of 5 years, children with digestive disorders that include colic infants - these two data collections would contain similar health records.

(4) comprehensive and thorough search capabilities including logical Boolean searches (AND, OR, and NOT), single words, phrases, multiple words in proximity, etc.

(5) advanced search features such as term weighting (some search terms are more relevant than others), relevance ranking where the search results are ordered in accordance to their importance, intuitive searching where the search is performed on a similarity to a portion of text or document, etc.

(6) maintain and keep search lists to audit previous searches and allow simple modifications to implement a new search query.

(7) support searches on structured and unstructured text, multilingual text, and embedded images.

(8) support searches on native formatted documents such as word processed data i.e. Word Perfect file format.

(9) allow the customization of user interfaces to satisfy unique data entry requirements.

The complete ML is implemented within an unique security architecture (48). The security process is based on the identification and authentication of individuals requesting access to the health record database. This access can be requested internally or from external sources. Access is only granted to authorized users of which the library software automatically audits all users' accesses. Patients can request or will be sent a monthly statement illustrating who has had access to their health records. Various levels of security access can be applied to different sections of the individual's health record i.e. psychiatric data can not be accessed by the general practitioner. The other aspect of the security shell deals with the data compression technology. Depending on the format of the data, different compression algorithms will be used. This forms another level of security for without the correct decompression algorithm to undo the original compression operation, the data remains

unusable.

PCS Patient Care Station

The PCS facilitates the interaction between the patient and ML services or between the medical staff and the ML. Each station has an unique addressable identification code ensuring a one-to-one correspondence between the patient's location and the ML. The PCS has four main components; a monitor (50) that can display normal NTSC video, RGB video, or any other interlaced/non-interlaced digital video formats, an interface unit (52) to communicate with the medical information network and a Personal Computer Memory Card International Association (PCMCIA) reader/writer (54) or equivalent smart card reader/writer, a wireless or Infra Red (IR) transmitter/receiver (56) to communicate with a Personal Data Assistant (PDA) (from NEC, AT&T EO, Apple, IBM, Fujitsu, etc.), and an input entry device (58) to facilitate patient/medical staff communication with the system (this entry device can be a remote or separate device or an integral component of the monitor). (Refer to Figure 4.)

Its operations are based around a user menu/submenu graphical interface which selects the desired/requested operation. Menu interaction is either effected through a touch screen on the monitor or through the remote interactive control device. Depending on the user, various menu formats would be implemented. For the patient, a large graphical image would be effected to facilitate the identification and selection of the requested service. For medical staff/physicians, a more detailed "Window"

type menu would be available to enable the selection of more detailed medical forms and services. The input entry devices, for these two types of users, may also be different. For the patient, a simple numerical entry would suffice (the pressing of a single digit key button) to select the requested service, whereas the medical staff could have a more sophisticated entry device to allow alpha-numeric data and features such as scrolling, cursor movement, etc. to be implemented. The interactive capability of the PCS allows the patient to order/select various services including meal selection, selection of a variety of entertainment packages including regular TV programming, movie videos on demand, video games, educational information, clinical data that the patient has been allowed to access, administrative information such as medical charges, and third party oriented services including those of the florist, chaplain, physiotherapists, etc. The data is transferred to and from the PCS in compressed digital format to minimize data loading on the network and then decompressed at the bedside when used. The decompression is accomplished via two means; the decompression algorithms are resident in the PCS such as the MPEG decompression technique for movie videos or the unique decompression algorithm is transmitted with the data file when transferred to the user. This would be the situation when specific lossless compression techniques are used in the processing of medical files relating to high resolution images i.e. MRI or X-ray video data.

With reference to Figure 5, for a coaxial cable implementation of the medical information network, normal CATV

signals can be received by the PCS through the CATV tuner/convertor (60) and routed directly to the monitor for display. Control of the CATV tuner is performed by the CPU (62) that has received its instructions (i.e. channel selection) from the input entry device interface (64). This input entry device interface unit may be an integral part of the monitor or a separate component of the PCS unit. The CPU is also connected to an internal bus (66) that handles data transfer and control/status signals which links internal memory (68), a graphics/decompression processor (70), the wireless transmitter/receiver for the PDA interface (72), and the PCMCIA reader/writer unit (74). A complementary RF tuner/converter (76) exists for the Video On Demand (VOD) requests. The CPU controls the channel and movie selection of the VOD tuner which routes the data to the demodulator (78) to restore the original digital data stream. A specific memory controller (80) is used to control the data (compressed video information) passed to the high speed memory device (82) that can either be magnetic, optical, (or combinations thereof), or solid state (includes flash card memory) depending on the amount of data transmitted. Upon playback, the compressed data is first decompressed by the decompression unit (70) and than processed by the D/A converter (84) and analog processor (86), depending on the video format to be displayed, and passed to the monitor (90) through the video switch (88). The audio (stereo) is processed by a separate processor (92) fed directly from the decompression unit.

Within the PCS interface unit is a health card reader and/or writer that is based on smart card technology. This

reader/writer can support various configurations of smart card technology be they based on solid state memory and microcontrollers (Hitachi, Motorola, SGS-Thomson, Bull, Catalyst, etc.), optical memory (Drexler, Canon), or combinations of the aforementioned. The standardized PCMCIA card slots are utilized. These cards can be used to maintain an electronic health record or other user information in digitally compressed format on each patient which can be appropriately modified and updated as health care is administered. The health card, by default, allows the network to track the location of the patient through the unique address ID of the bedside PCS and the uniqueness of the patient's health card. Therefore the system will always know the exact location of each patient at all times even if the patient is moved, for as soon as the patient's health card is inserted in the smart card slot of the PCS, the network will register this initialization automatically. As long as the patient is at this bed location, the health card remains inserted in the PCS.

The PCS can also be located at the residence of the patient. This will facilitate the out-sourcing of health care to external health care service providers. The PCS can receive from the ML post recovery rehabilitation information in the form of video and text data, special dietary/nutrition instructional data, physical rehabilitation programming, etc. The PCS will also be able to be interfaced with specific monitoring equipment to register and track certain parameters such as temperature, pulse rate, etc., process this data, and transmit the results back to the ML. In association with a PDA carried by an external care giver,

detailed health record information can be accessed, and modified with up to date medical diagnostic data.

The monitor can either be that of a Cathode Ray Tube (CRT), Liquid Crystal Display (LCD), or newer technologies such the diamond-based video and computer display panels. The display will be interlaced or non-interlaced depending on the resolution required for the specific application, and has the optional capability of displaying digital video data. The monitor, as an option, will have built in hardware and associated resident software (such as by NEC) in the display driver to facilitate Display Power Management Signalling (DPMS). This feature has the capability to place the monitor into four different power states: on, standby, suspend, and off, depending on the activity of the PCS. This will result in significant energy savings, especially during periods of relative inactivity, where the monitor can be placed in an efficient power mode.

Several options exist with respect to the PCS. The PCS may contain enough internal memory (as previously described) to allow the downloading of video on demand movies from the ML. Additional PCMCIA slots can be added to facilitate features such as FAX/modems, expanded memory requirements, special interfaces to local area network systems i.e. DEC Ethernet, etc. The PCS can also be equipped with a simple magnetic stripe card reader and/or writer to accommodate other types of health cards. A special optional feature of the future would include that of voice recognition software/hardware to facilitate the entry of health record information via voice. Included in this feature would be

the use of an individual personality PCMCIA card, to customize the voice recognition software to the individual's unique voice attributes. This eliminates the need to train the voice recognition software which could take a sufficient length of time and likely lead to significant errors during this training period.

The following items/systems can be considered as preferred options to the master library, the medical information network, and the PCS.

Electronic Health Records

Integrated with the PCS as previously mentioned, will preferably be a smart card reader/writer unit. The intent is to provide complete electronic health record in digital compressed format supplying as much medical information on the patient as possible i.e. blood type, vaccination and medication data, diabetic controls for blood sugar levels, allergy data especially when drug related, etc.

The health card's memory will be divided into explicit regions.

(1) Personal Data - personal ID that contains a video compressed image of the individual to authenticate the user, other personal data (name, address, next of kin, date of birth, etc.), insurance coverage, etc. Once user verification has been ascertained, access to the remaining medical data would be granted.

(2) Emergency Data - contains data of life saving importance i.e. blood type, allergies, any medication, immediate medical history relating to patient status such as diabetes, Parkinson's disease, dialysis treatment, etc. This data would be available to anyone who has a card reader unit such as in an ambulance or carried by a home health care service individual.

(3) Medical History - contains the medical history of the patient including past diseases, injuries, operations, etc. and associated treatments. This area, once access has been granted through item 1), can be further sub-divided into medical disciplines i.e. general practitioner data, specialist and surgeon data, psychiatric data, etc. each accessible by only those authorized to its access. Pertinent video images relating to radiology, X-rays, etc. will be stored through digital video compression techniques.

(4) Present Examination Data - documentation of the actual examination, who performed it, where and when, and the diagnosis with the prescribed medication, if any. This area is automatically entered into the medical history area when a new examination occurs. A comparison of past examinations can be performed to determine if the

patients state of health has improved or deteriorated.

The entire operation (access and data retrieval) with respect to the use of the health card, is protected with a security envelop. Medical data is fully encrypted, data integrity is assured, access is rigidly controlled, and access audit trails conveniently maintained.

To enable interaction with the electronic health record resident on the health card, pen based computer or Personal Data Assistant (PDA) technology is utilized (reference Figure 6). This PDA technology will contain PCMCIA slot(s) that can be used to read and/or update the health card. When the health card is read, the data is suitably decompressed before viewing on the PDA. When health care is to be administered, the patient's health card is inserted in the pen based technology and the health status/history can be viewed. The examining personnel can then add to these electronic medical records, via the PDA technology, in accordance with the present diagnosis or medical status update i.e. the present examination data area is modified. This new information is entered through the PDA technology by simply writing as normal on the pen display tablet. If further information is required that is not resident in the patient's card, the ML can be accessed to acquire further data from the master electronic medical record kept on file. This information is transferred from the ML to the unique PCS that has requested the additional information in digitally compressed format and then to the pen based system via wireless

communications or broadband IR communications (102). The additional information is then decompressed for viewing purposes. If this additional information has been that of a high quality medical image, the PDA can request the viewing of this data on the patient's monitor to take advantage of its enhanced resolution. In the case where medication has been assigned, a validity check can be performed against any present patient medication (as indicated in the emergency data area of the health card), to ensure against medication incompatibilities. This check is accomplished with respect to a pharmaceutical database maintained in the ML.

To ensure authorized personnel are only allowed access to the overall system network, a secure signature pen (104) is used. This pen contains an internal memory (Dallas Semiconductor) with an encrypted personal signature of the medical personnel, which once validated by the system, allows access to the network. This personal signature is stored in the pen memory in digitally compressed format that is transferred to the PDA when the pen is initially touched to the PDA tablet. A master file of all authorized users is held in the PCS or the nursing station for validation purposes. The compressed signature file is transmitted to the PCS through either wireless or broadband IR communications where it is decompressed for comparison validation purposes or if the master signature file is located at the nursing station, transferred there in compressed format for further validation. Once validation has occurred, an indication is transferred to the ML administrative software management system that network access has been granted. This is an unique one to one relationship that

is established when the medical person picks up the PDA technology at the nursing station. This technique also provides an unique audit trail for the network can track the authorized personnel granted access and at what time this access was initiated.

All the appropriate standardized medical forms are stored in the PDA's memory and accessed through a simple menu window. Custom forms can be generated as required. The data entry is kept to simple operations as much as possible to reduce the amount of handwritten text to minimize errors and enhance performance. Each time the PDA is loaded into its docking slot located at the nursing station its software clock is synchronized with the clock of the master library. This ensures an accurate time audit trail being associated with each patient's health record as to when it was changed/updated and automatically entered into the master library. The PDA can also contain a paging unit eliminating the need for medical personnel to carry a separate paging device. Personal messages can be routed to the appropriate medical staff because the system, through the unique one to one relationship established between the user's pen and the PDA, knows the location of that individual.

The PDA will replace the paper clipboard and allow the user to interface to an electronic database. Patient information can be loaded to/extracted from the PDA. All the information passed to/from the ML or the nursing stations is in data compressed format thus enabling the transfer of video images i.e. X-rays to the bedside station if so desired. The following items identify specific features that will be functions of or options available

that make this PDA technology especially suited for this application.

(1) conversion of hand written material into neat text with word processing features to edit what has been written.

(2) electronic table of contents facilitating ease of data search and retrieval. Integral medical forms facilitating data entry.

(3) interface with a separate docking unit where information can be exchanged between the pen based computer and the distributed processor at the nursing station. This can be accomplished through an infra red link or wireless communications. Recharging of the integral battery pack is also implemented when the pen based computer is resident in the docking slot.

(4) voice annotation to modify or correct pen entered data. Voice entry through a head set or through an embedded microphone would effect a hands free data entry operation.

(5) built in paging capability to receive messages from an external source i.e. Hospital emergency services.

(6) an integral PCMCIA slot(s) that enables the interface with the health card and any other PCMCIA compatible cards.

Automated Nursing Stations

Based around a distributed processing network, each nursing station consists of a client/server configuration with enough memory (CD-ROM, magnetic disk, or solid state RAM) to temporarily store the entire health records (in compressed format) for the patients who are resident in the beds monitored by this station. This distributed processor node can be dedicated to a hospital wing, or several wings but only controls a specific number of beds. It is also the central location of the PDA docking slots that are interfaced to the nursing station processing unit. Each patient's health record is maintained at the nursing station until the patient is either moved or discharged. The records are downloaded from the master library in compressed format when the patient is admitted to a bed monitored by the nursing station. The ML knows the location of this patient through the unique association of the health card and the patient care station and the nursing station/bed system architecture.

When care is to be administered, the medical staff picks up the PDA from its docking slot and takes it with them to the appropriate room. Updating of the health record is performed through the secure signature pen and the PDA display tablet. Initially, upon admittance, the patient's health card is inserted into the PDA to determine the patient's present (or most recent) medical status and any further supporting medical history data that is deemed relevant. The medical personnel then updates the medical record in accordance with the administered health care. The PDA automatically transfers the modified health record or portions

compressed first before transmission to the ML. This modified data is held in a temporary record file separate from the original health record though linked to it. This continuous updating of the ML facilitates the capability of external users, such as general practitioners, to access their patient's files to determine the latest health care status.

The modified electronic health records are maintained at the nursing station until the patient is discharged from the hospital or moved to another location that is controlled by another nursing station. Upon patient discharge, the patient's complete updated electronic health record is transferred back to the master library in compressed format and replaces the original record resident there (the original record is replaced with the new one and the temporary record file destroyed). If hospital policy dictates that past records are to be kept or changes to the original be archived, the original health records can be maintained. When the patient is discharged from the hospital, at the last control point, their health card is updated with the particulars of the most recent administered health care. The health card always remains with the individual to facilitate home health care services with medical personnel that may administer health care in the patient's home.

Because the electronic health record is based on pre-established formats that is resident in the PDA, it is very easy to determine changes or additions to patient records or identify new ones. Changes to patient medication or care are very easy to determine, and as a result the nursing station processor can

extract this information and automatically indicate to the nursing staff any changes to the patient's care that may have to be administered. As a fail safe check these changes are highlighted at the nursing station. The nursing staff acknowledges receipt by entering an acknowledgement check in the original health record which has been copied into the nursing station memory.

The Central Library

Remote from the hospital sites or regional master libraries, a central library will be established. These are large data storage complexes (202) based around a large computer system (Cambridge, Convex, IBM, etc.) and mass memory storage (204) (Storage Technology, Ampex, EMASS, or Metrum Peripheral Products). Refer to Figure 7a and 7b. This central library has the capability to compress video data (video compression systems (206) available from IBM, DEC, SGI, etc.) to suitable quality levels determined by the application i.e. movie video distribution, educational videos, medical training packages with high resolution medical images, etc. As a result, the central library will contain several compression algorithms in various forms of software and hardware (C-Cube, Optibase, XING, Apple, etc.) and thus can take advantage of the latest development in compression technology. Compression capabilities for textual and graphical data will also reside in the central library. These compressed products can then be distributed via video servers (226) and high speed memory buffers (228) back to the hospitals master libraries, to third party users such as medical training universities, to clinics/laboratories, physician

offices (208), and even to patient's residences if necessary. This distribution can be via DBS, fiber optics, coaxial cable, wireless means, or twisted pair telephone cabling depending on the communications capability at the user facility and the amount of data and the required bandwidth necessary to implement distribution.

The central library can also be customized to allocate dedicated services to specialized medical research fields (210) i.e. cancer, diabetes, altziemers, etc. This is accomplished by acquiring all the relevant information on the specific field from all the interconnected hospital master libraries. Applicable confidential patient identification has been purged from this data, leaving only the relevant medical data. A similar software management capability as described for the master libraries allows the complex search/data sort requirements requested by the users. Each user pays a per use access fee for these research oriented databases.

This central library also acts as a distribution hub for the dissemination of new medical information or electronic medical literature in compressed format. This is especially relevant to large hospital organizations that require the dissemination of information to all their member hospitals. New information relating to new drug types (224) and their use and application can be distributed automatically to interested parties i.e. users that have been screened into specialized categories or broadcast in general to all users. These authorized users will include registered hospitals, medical clinics, and the offices of general

practitioners with the distribution of data via DBS, fiber optics, coaxial cable, or telephone cabling (212). Typical data such as this will likely contain images, so the data will be appropriately compressed to permit the distribution of video images and to minimize the communication link charges. Other typical types of information could include data pertaining to new prothesis components, literature relating to new/changes to medical coverage insurance plans, changes to legal/governmental medical policy, etc. The central library becomes a centre for the dissemination of all medical related information. This will encourage the expansion of the overall medical network system.

The central library will also contain all the necessary software authoring tools to (Video for Windows*, Actionmedia II*, Indeo*, Quicktime*, etc.) allow the production of medical educational and training materials. It also contains the hardware to generate CD-ROM masters (214) to assist in the distribution of this training material. This is extremely important with respect to the association between the central library, the offices of the general practitioners, medical clinics, lobbies of hospitals, and other medical facilities. A medical diagnostic node (information kiosk) (216) can be established at each location consisting of a PC, a monitor, and a CD-ROM player. Through an interactive menu, the individual could scan through a database to conduct a preliminary self diagnosis, obtain information on specific drugs, their application and any potential effects, nutrition and dietary data, etc. The intent is to make the individual more informed as to their own medical problems and related health care. To

complement this capability, a phone in line known as HealthTel (218), would be staffed by expert medical personnel to assist in further diagnosis or for the general dissemination of medical information.

In association with the central library (not necessarily at the same location) would be a centralized warehouse for the distribution of all medical supplies or consumables. This warehouse (220) would be linked with the hospital's master libraries or an organization's overall inventory control system to automatically order, distribute, and invoice for the requested medical merchandise. This would be effected through the use of standard Electronic Data Interchange (EDI) file formats for order forms, invoices, etc.

The central library would also contain a maintenance diagnostic centre (222). From this facility a maintenance technician could access any master library and indirectly any PCS unit, and invoke the running of maintenance diagnostics. Thus from a remote facility, equipment servicing can be accomplished to assist local maintenance personnel in the diagnosis of equipment failures.

Thus it is apparent that there has been provided in accordance with the invention that fully satisfies the objects, aims and advantages set forth above. While the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such

alternatives, modifications and variations as fall within the spirit and broad scope of the invention.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. — An electronic information system for distribution of medical information and patient services comprising:

(a) a data source in the form of a master library (ML) storing data in digitized compressed electronic signal format;

(b) a communications interconnection system electronically associated with the master library;

(c) an automated nursing station electronically associated with the master library through the communications interconnection system for temporary storage of a patient's health records, comprising computer means incorporating a client/server configuration and sufficient memory to temporarily store health records for patients monitored by this station;

(d) an electronic patient care station (PCS) comprising:

(i) a monitor screen for display of normal NTSC video, RGB video and interlaced/non-interlaced VGA/SVGA video formats;

(ii) interface means to electronically communicate through the communications

A

interconnection system with the master library and with the nursing station;

(iii) a wireless/IR transmitter/receiver to communicate with a pen based computer device;

(iv) an input entry device to facilitate patient/medical staff communication within the system; and

(v) compression and decompression means for data passed to and from the patient care station.

2. A system according to claim 1 comprising a plurality of nursing stations, one or more patient care stations being electronically associated with each said nursing station.

3. A system according to claim 1 wherein the automated nursing station is further provided with compression and decompression means for data passed into it.

4. A system according to claim 1 wherein the master library is adapted to store data selected from one or more of the following:

(a) patient/medical staff health record information,

(b) clinical data including X-Ray, MRI and video images,

(c) relevant laboratory data to support medical diagnoses and investigations,

A

(d) educational/training information in video or textual format for training of medical personnel and patient requirements,

(e) pharmaceutical databases,

(f) entertainment audio/video data,

(g) monitored video of critical areas such as operating rooms and psychiatric wards,

(h) general security video monitoring data.

(i) management information data including accounting/billing and inventory control/ordering services.

5. A system according to claim 1 wherein the master library is provided with means to receive and store, in digitally compressed form, data from one or more of the following:

(a) physicians offices;

(b) clinics and laboratories;

(c) video entertainment libraries;

(d) electronic medical libraries;

(e) hospital security, patient and operating room monitoring information

(f) patient's residences.

6. A system according to claim 5 further comprising one or more decompression and monitoring means electronically associated with the master library to provide professionals with access to the

information stored therein.

7. A system according to claim 1 wherein the monitor is a unit selected from the group comprising a cathode ray tube, liquid crystal display and computer display panels.

8. A system according to claim 7 wherein the monitor has the appropriate hardware and software to facilitate Display Power Management Signalling.

9. A system according to claim 2 wherein each patient care station is provided with a unique addressable identification code ensuring a one to one correspondence between a corresponding patient's bed location and a patient's file in the master library.

10. A system according to claim 9 wherein the PCS incorporates a PCMCIA reader/writer(s) to receive, read and write a smart health card unique to the corresponding patient, and to facilitate optional features including extra memory, FAX/modems, special LAN interfaces, and user personality cards.

11. A system according to claim 1 wherein the patient care station is further provided with internal memory means for storage of data in digitally compressed form and decompression means for display of such data on the monitor.

12. A system according to claim 11 wherein the patient care

station is programmed to provide an interactive menu to allow selection of services comprising:

(a) meal selection,

(b) selection of electronic entertainment and information packages selected from the group comprising regular TV programming, movie videos on demand, video games, educational information, clinical data and administrative data;

(c) and third party oriented services selected from the group comprising florist, giftshop, chaplain, physiotherapist.

13. A system according to claim 1 wherein the patient care station is further provided with external pen based computer means (PDA) for reading smart health card patient information and documenting medical diagnosis; and means integral electronically with the patient care station for receiving a health card for reading or amending the data stored on the health card.

14. A system according to claim 13 wherein the integral electronically means is a PCMCIA smart card reader/writer.

15. A system according to claim 1 wherein the communications interconnection system is provided with a cable switched voice means to interface between the patient and a public telephone network.

16. A system according to claim 1 provided with data storage, search and retrieval means implemented through an interactive software means.

17. A system according to claim 1 that incorporates around the ML a security architecture to authenticate and grant user access to only those authorized.

18. A system according to claim 1 that incorporates a security architecture around the PCS and PDA authenticate and grant user access to only those authorized.

19. A system according to claim 1 that contains a secure signature pen to be used in association with the PDA that contains a digitized compressed replica of a user's signature.

20. A system according to claim 1 that audits access to all archived electronic health records in the ML.

21. A system according to claim 1 wherein the data is passed to and from the master library by means selected from the group comprising DBS, fiber optic, twisted pair, co-axial cable or wireless communication.

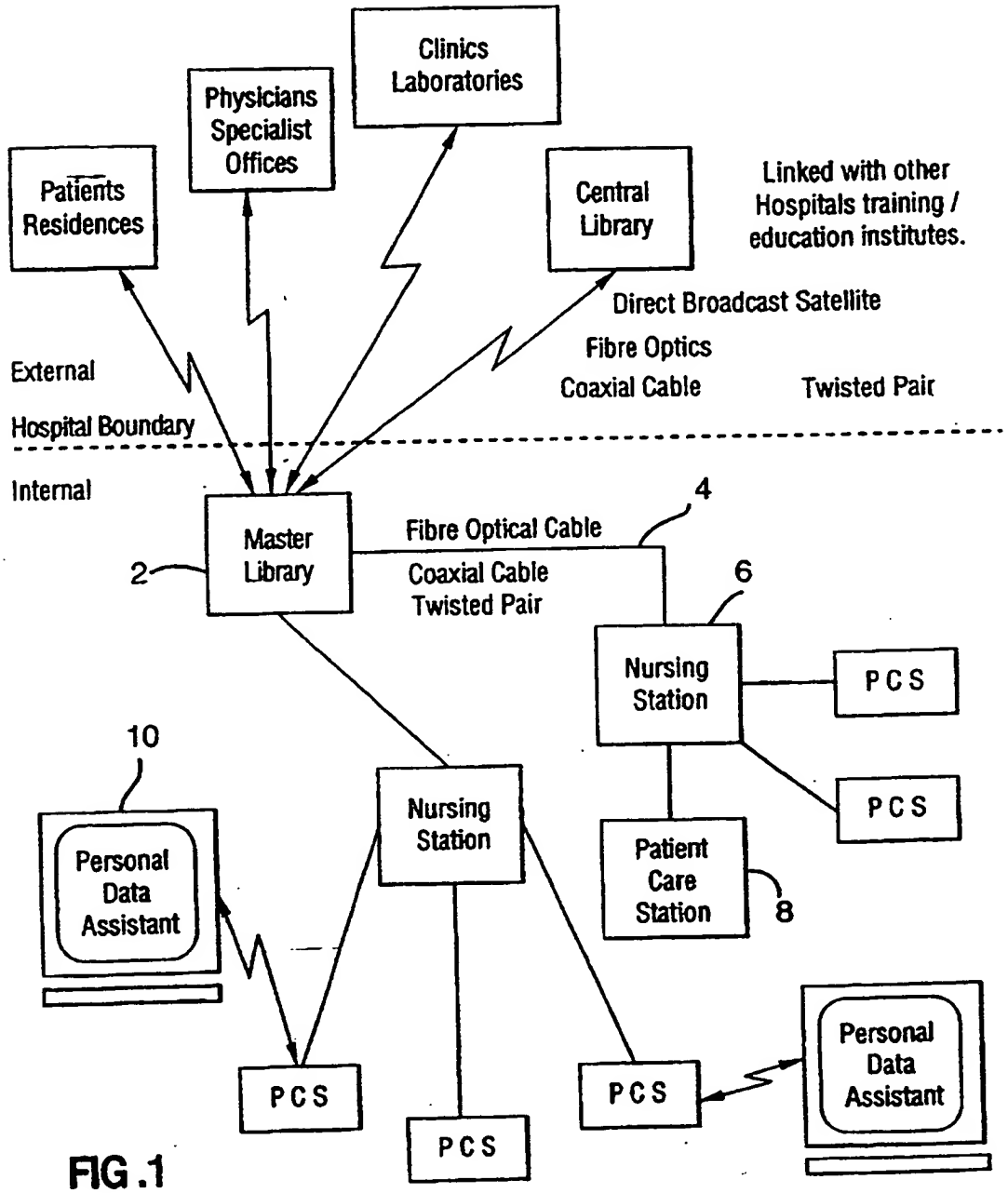


FIG.1

Inventors: Douglas J. Ballantyne
Michael Mulhall

Patent Agents: Burke-Robertson

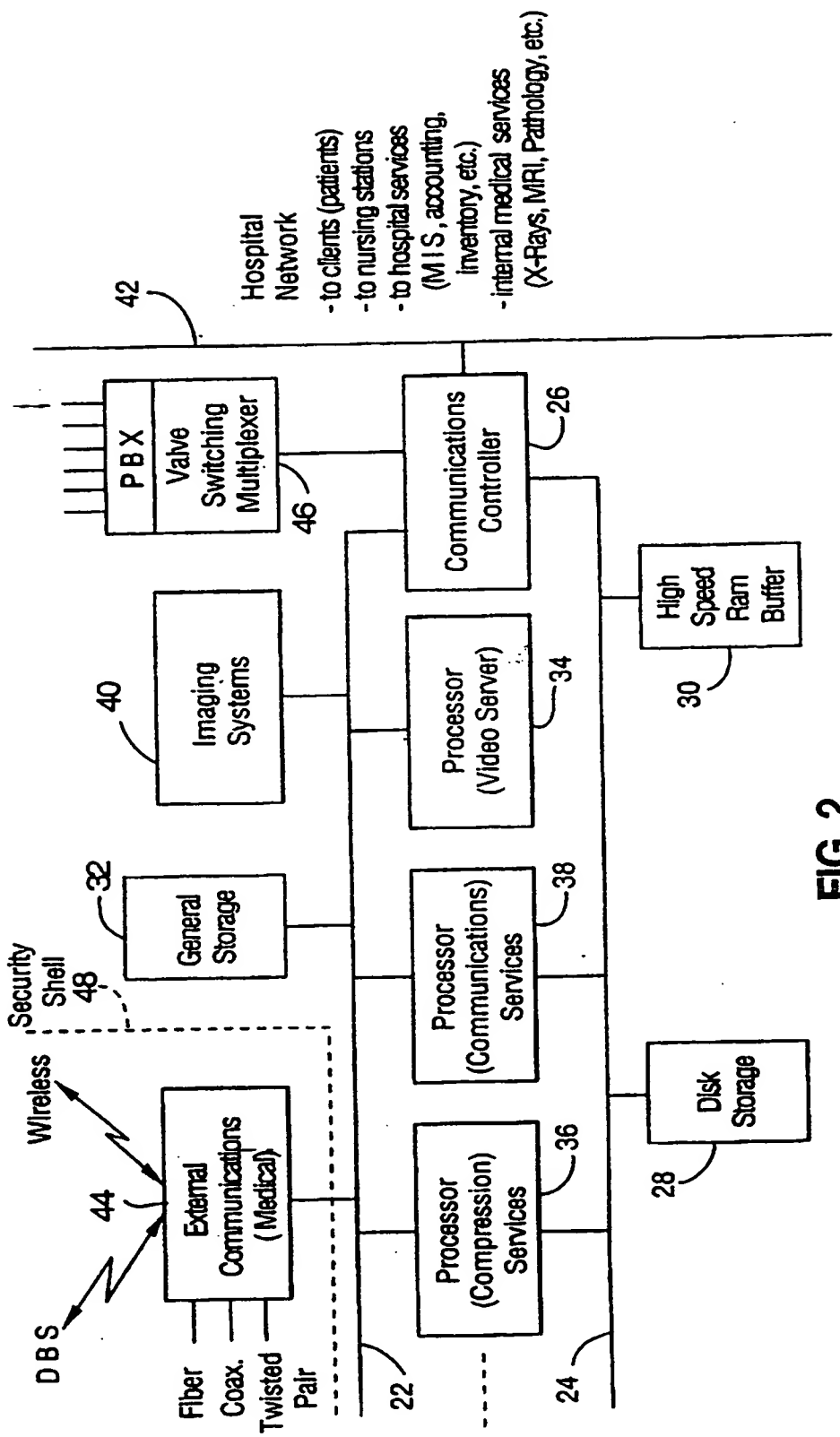


FIG. 2

Inventors: Douglas J. Ballantyne
Michael Mulhall
Patent Agents: Gudka-Robertson

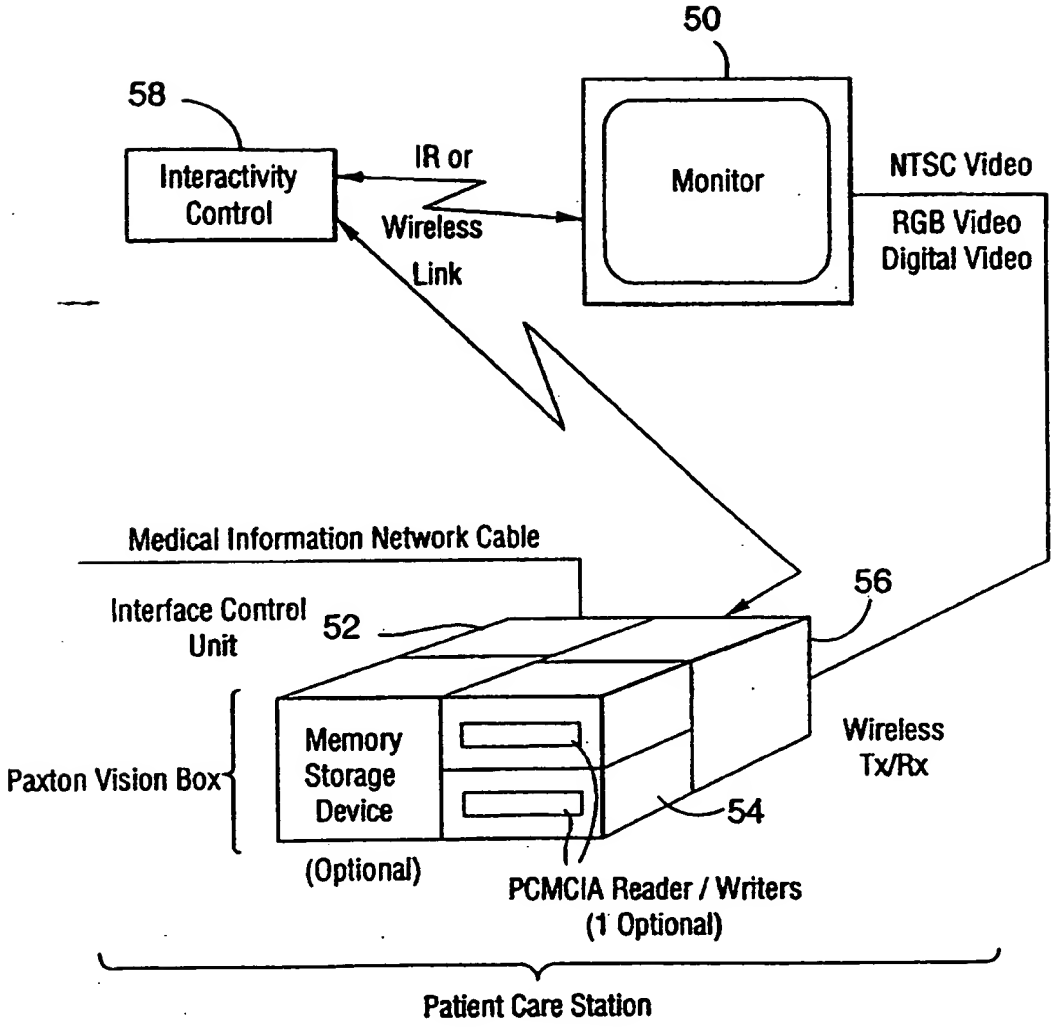


FIG. 4

Inventors: Douglas J. Ballantyne
Michael Mulhall

Patent Agents: Burke-Robertson

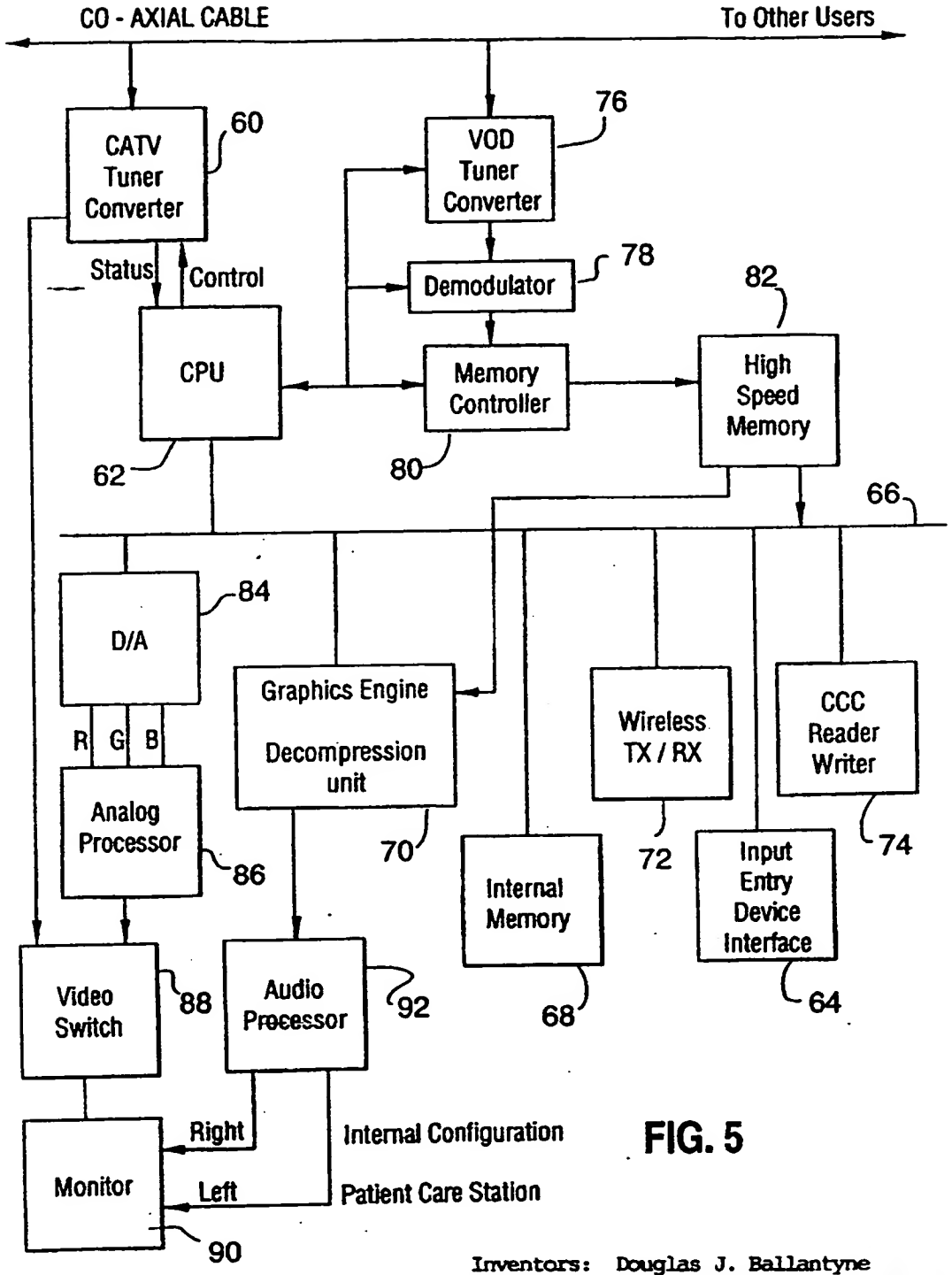


FIG. 5

Inventors: Douglas J. Ballantyne
Michael Mulhall

Patent Agents: Burke-Robertson

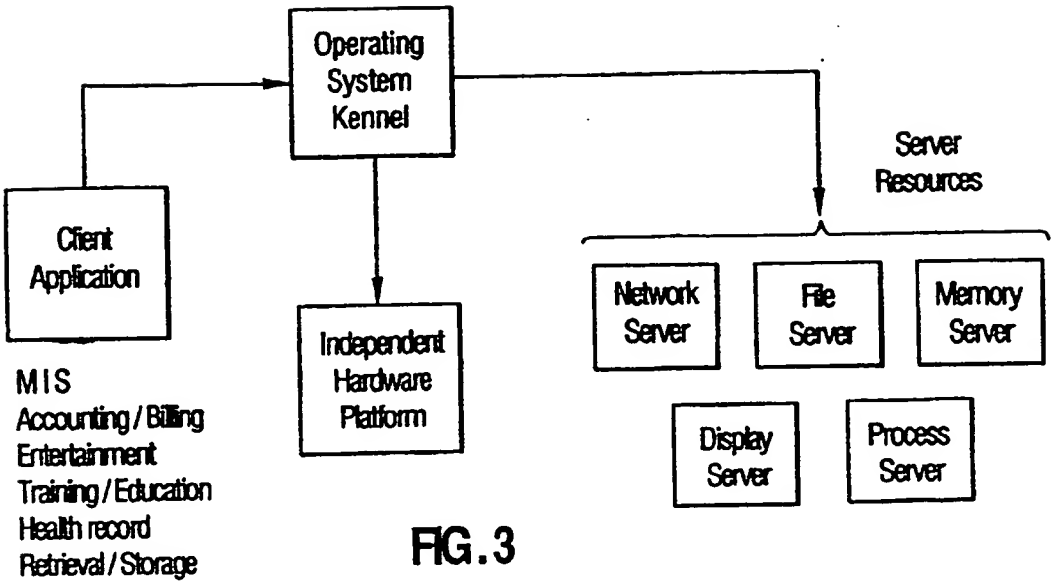


FIG. 3

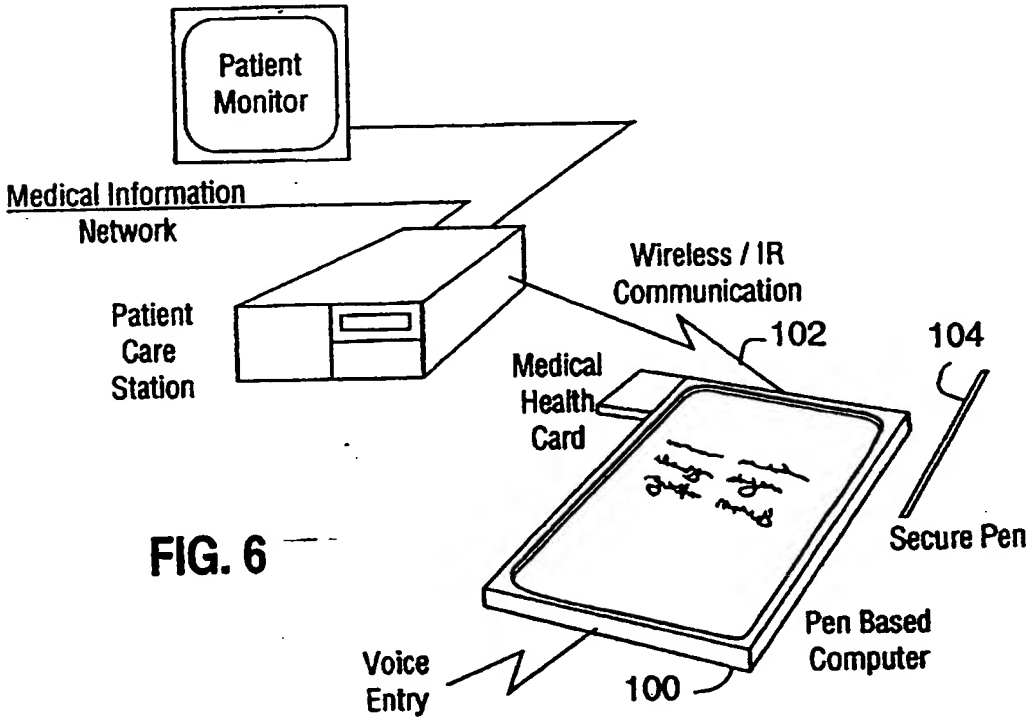


FIG. 6

Inventors: Douglas J. Ballantyne
Michael Mulhall
Patent Agents: Burke-Robertson

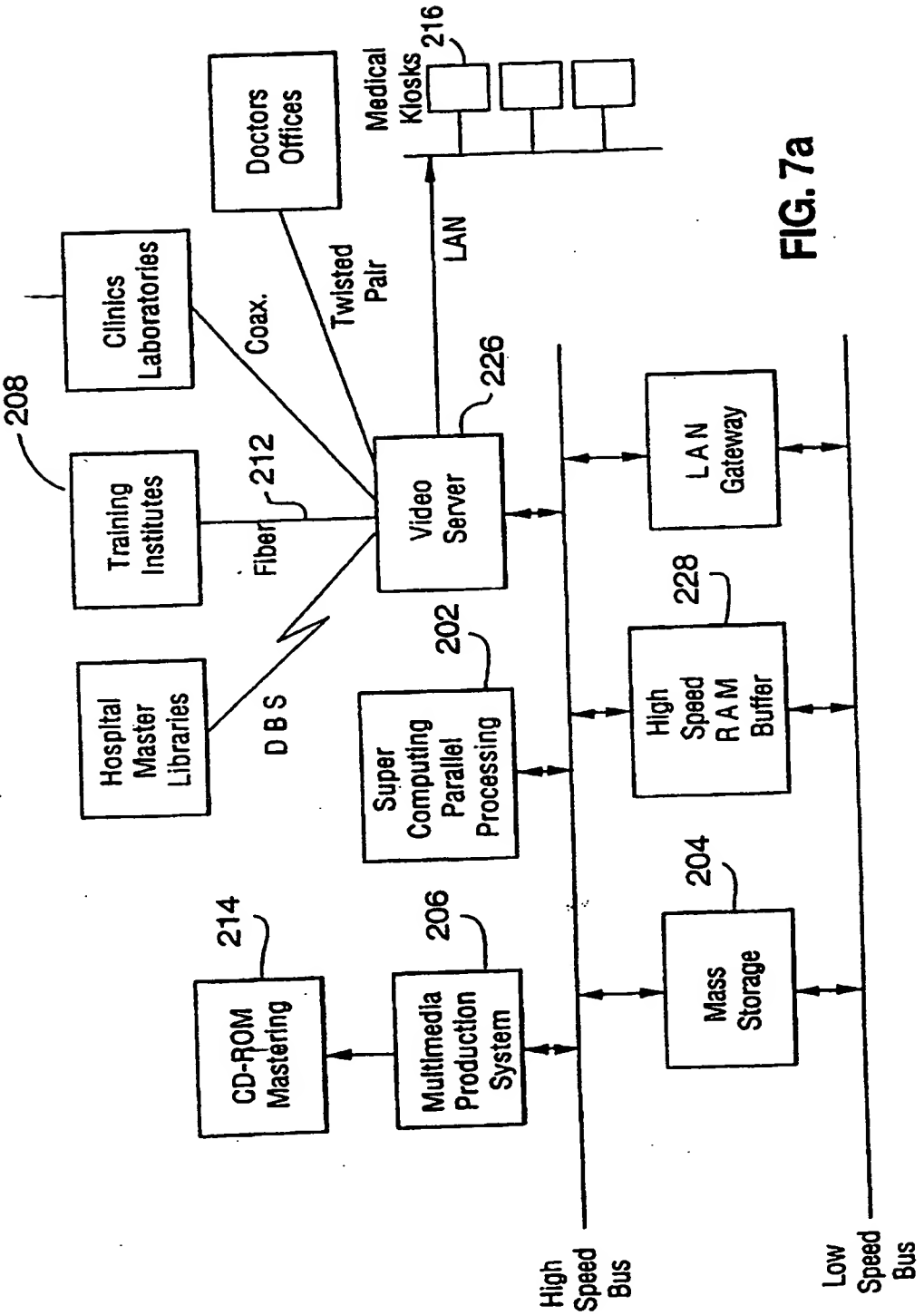


FIG. 7a

Inventors: Douglas J. Ballantyne
Michael Mulhall

Patent Agents: Burke-Robertson

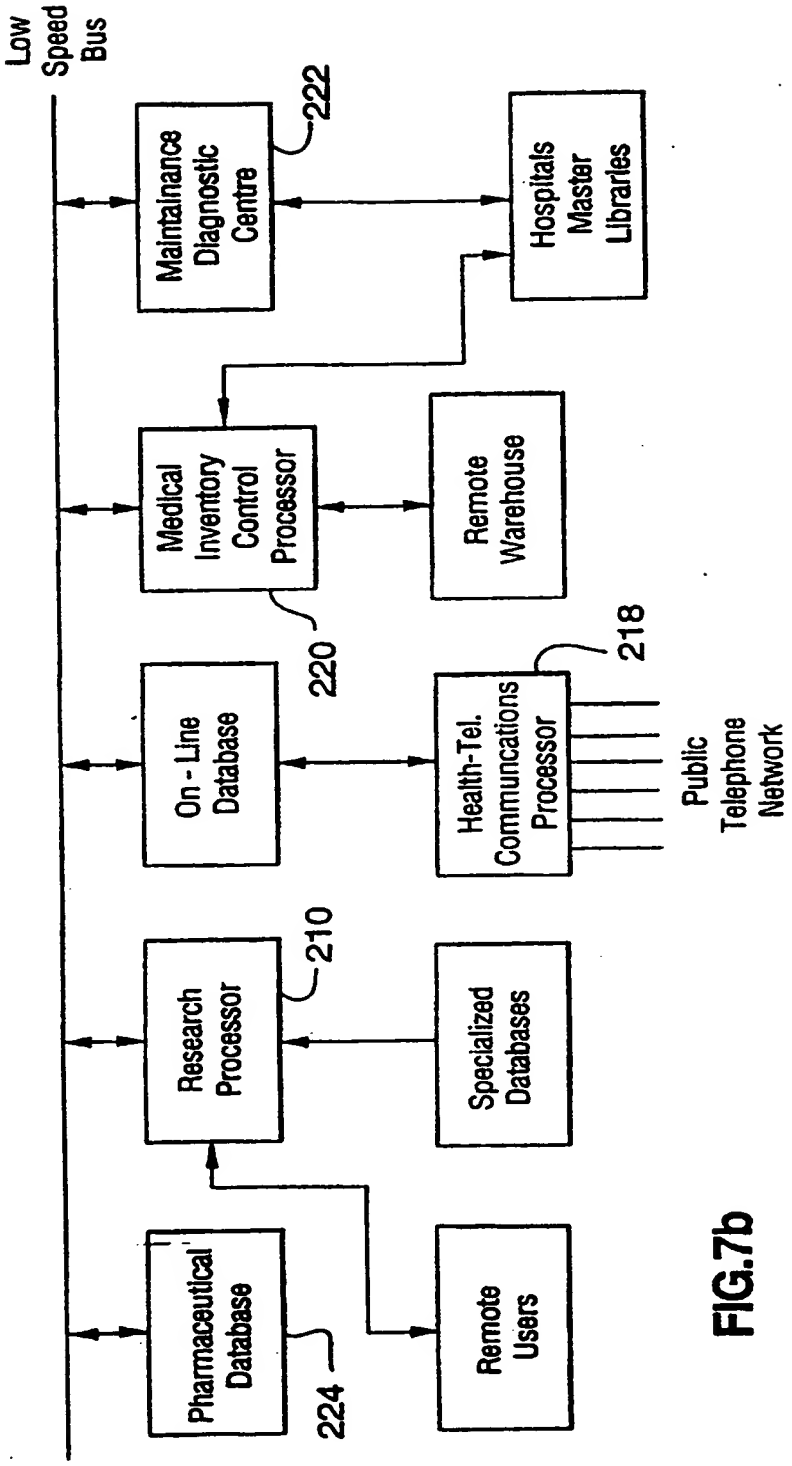


FIG.7b

Inventors: Douglas J. Ballantyne
Michael Mulhall

Patent Agents: Burke-Robertson